Basilar bifurcation aneurysm approaches

Subtemporal approach

Right subtemporal craniotomy (classical approach of Charles George Drake): approached through the tentorial incisure or division of the tentorium. Most basilar tip aneurysms are probably best approached via pterional approach except for posteriorly pointing aneurysms.

a) advantage:
- less distance to basilar artery tip
- may be better than pterional approach for aneurysms projecting posteriorly or posteroinferiorly

b) disadvantages:
- requires temporal lobe retraction (minimized with lumbar drainage, mannitol, and possibly zygomatic arch section)
- poor visualization of contralateral P1 segment and thalamoperforating arteries.

For Juha Hernesniemi et al., the subtemporal approach is simple and safe in experienced hands, and should be considered the standard method to approach most basilar bifurcation aneurysms.

Pterional approach

pterional approach (described by Gazi Yasargil): trans-Sylvian

a) advantages:
- little or no retraction on temporal lobe (unlike subtemporal approach)
- better visualization of both P1 segments and thalamoperforators
- other aneurysms, e.g. of the anterior circulation, can be dealt with at the same sitting

b) disadvantages:
- increases reach to aneurysm by ≈ 1 cm compared to subtemporal
- requires wide splitting of the sylvian fissure
- operating field is narrower than subtemporal approach
- perforators arising from the posterior aspect of P1 may not be visible

Modified pterional craniotomy: may allow trans-sylvian or subtemporal approach. The craniotomy is taken further posteriorly than a standard pterional craniotomy
Orbitozygomatic approach: allows access to portions of the basilar artery below the bifurcation. May be augmented by removal of the top of the clivus.

Optional resection of the temporal tip will increase exposure of either approach. Unlike most anteri- or circulation aneurysms, securing proximal control is very difficult.

If the basilar bifurcation is high above the dorsum sella, then more retraction is required on a subtemporal approach than for a normal bifurcation height (near the dorsum sella). A high bifurcation is dealt with on a trans-sylvian approach by opening the sylvian fissure more widely, or by a subfrontal approach through the third ventricle via the lamina terminalis. A low bifurcation may require splitting the tentorium behind the 4th nerve.

Risks include: oculomotor palsy in ≈ 30% (most are minimal and temporary).

Approach is from the right unless:

1. additional left sided aneurysm (e.g. p-comm aneurysm) which could be treated simultaneously by a left sided approach

2. aneurysm points to the right

3. aneurysm is located to the left of midline (the operation is more difficult when the aneurysm is even just 2–3 mm contralateral to the craniotomy).

4. patient has right hemiparesis or left oculomotor palsy

Rotate the head ≈ 30° off the vertical so that the malar eminence points directly upward

Slight neck flexion is used for low-lying aneurysms, slight extension for high ones. Craniotomy with aggressive removal of the sphenoid wing. The sphenoid wing and the orbital roof may be reduced with a drill. The posterior clinoid can be removed to improve exposure.

The sylvian fissure is split until the take-off of the proximal M1 segment of the middle cerebral artery from the carotid terminus is identified. The approach is medial to the ICA (between the ICA and optic nerve) when this space is ≥ 5–10 mm. If the ICA is close to the optic nerve, an approach lateral to the ICA may be used, aided by medial retraction of the ICA/M1 segment.

Here, the exposure is limited by the height of the M1 branch above the skull base, and if the basilar tip height above the skull base greatly exceeds this, clipping via this approach is not feasible.

The oculomotor nerve is identified. Also the p-comm and the anterior choroidal artery (AChA) are located as they arise from the posterior surface of the ICA (to differentiate between them: the p-comm origin is proximal to that of the AChA, p-comm courses perpendicular to Liliequist’s membrane whereas AChA courses obliquely into the crural cistern). The p-comm is followed posteriorly through Liliequist’s membrane which is opened revealing the prepontine cistern. The p-comm is followed until it joins the PCA at the P1/P2 junction. If p-comm is absent, follow the third nerve back to find where it emerges between PCA and SCA. P1 is followed proximally to the basilar bifurcation region where the contralateral P1 and both SCAs are identified. Caudal dissection of Liliequist’s membrane exposes the interpeduncular cistern with proximal BA (this exposure is critical for proximal control of BA in the event of aneurysmal rupture).
Thalamoperforating arteries (ThPAs) arise from the distal p-comm and proximal PCA, and often compromise the access. Early poor results with clipping of basilar tip aneurysms has been attributed to sacrificing these vessels, which produces lacunar infarcts in the thalamus, midbrain, subthalamic, and pretectal regions. If hypoplastic, the p-comm may be divided between clips to improve exposure (preserving the ThPAs which will then arise from the stumps). Similarly, a hypoplastic P1 may be divided if the PCA fills from the p-comm. If the ThPAs make it impossible to clip the aneurysm, some may have to be sacrificed, which is best done at their origin. Fortunately, there are some anastomoses and thus they are not entirely end-arteries as originally thought.

In 2005 Yonekawa et al. from the Department of Neurosurgery, University Hospital Zurich, Switzerland, suggested following strategies and tactics for safe and secure occlusion of aneurysms of this location: pterional approach, selective extradural anterior clinoidectomy SEAC, no transection of the posterior communicating artery, isolation of perforating arteries at the time of neck clipping with oxycellulose and combination of the use of fenestrated clip and conventional clip (especially for aneurysms projected posteriorly), controlled hypotension (systolic pressure of around 100 mmHg), temporary clipping (trapping) procedures of usually less than 15 min. All these are aimed for prevention of intraoperative premature rupture, and of injury of perforating arteries and for complete occlusion of aneurysms in the narrow depth of the operative field.

In 1994 Kobayashi and Tanaka reviewed their experience and surgical techniques for clipping basilar bifurcation aneurysm. A multidirectional approach is proposed for difficult or unusual aneurysms. Some clipping techniques found useful are described.

de Sousa from Faculdade de Ciências Médicas de Minas Gerais, Brazil, in 1998 described his experience with 123 operated patients of basilar bifurcation aneurysms from January 1977 till December 1995. In these 123 consecutive surgeries the results were 85% good outcome, 8.1% morbidity, and 6.5% mortality. In the first years of this series the pterional or subtemporal approaches were used, depending on the level of the basilar bifurcation, the exact origin of the sac, its projection and size. From 1987 on all patients were operated by a modified pterional approach described initially by Sano as temporopolar approach.

Access routes to the interpeduncular cistern or prepontine cistern for observation of the aneurysms include the pterional approach, subtemporal approach, and transpetrosal approaches; the specific approach is selected on the basis of aneurysm size, the projection of the dome, and the location of the neck of the aneurysm. The orbitozygomatic approach (OZA) has been useful in accessing BX aneurysms, especially in cases where it is in a high position, because this approach can facilitate upward and oblique viewing from below through the wide operative space.

However, the OZA needs additional removal of the orbital rim and zygomatic arch, in addition to standard pterional craniotomy, which increases invasiveness, the risk of facial nerve palsy, temporal muscle atrophy, and deformity after surgery, and results in an extended operative time. Appropriate selection of the OZA requires indications that have yet to be established. The trajectory to BX aneurysms in the interpeduncular or prepontine cisterns has been suggested to be related to not only the height of the apex of the basilar artery (BA), but also the height and lateral breadth of the bifurcation of the internal carotid artery (ICA).

Simulation using 3DCTA appears to be important for planning the surgical approach for the treatment of BX aneurysms.
The α angle widens with age during adulthood, especially in females. This angular widening is associated with basilar bifurcation aneurysms and may predispose individuals to aneurysm initiation by diffusing the flow impingement zone away from the protective medial band region of the flow divider\(^2\).

**Basilar artery apex aneurysms** are challenging lesions for both microsurgical and **endovascular therapy**. In patients in whom direct clipping and coil embolization are not options, cerebral revascularization and occlusion of the basilar artery is a possible treatment strategy.

Kalani et al., report a patient with a large basilar apex aneurysm treated by double-barrel anastomoses of the superficial temporal artery to superior cerebellar artery bypass (STA-SCA) and the STA to the posterior cerebral artery (STA-PCA) followed by occlusion of the basilar artery below the SCAs. A double-barrel bypass augments blood flow to the brainstem. They report a novel bypass option for augmenting blood flow to the basilar apex and brainstem\(^3\).

In 1998 a article reviews the natural history, clinical presentation, evaluation, and selection of treatment approach and details various surgical techniques. The use of endovascular techniques is reviewed briefly\(^4\).

### References


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